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A Case-control Study of Risk Factors for Low Back Injury in Employees of a Large Home Improvement Retail Company

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I. Introduction

Low back pain (LBP) is a very common health problem in industrialized countries. Lifetime prevalence of LBP exceeds 70%, with peak point prevalences between ages 35 and 55 (Jellema P et al, 2001). Low back injuries constitute a major cause of musculoskeletal injuries in the workplace (Felstein et al, 1993; Genaidy et al, 1995), and are recognized as the leading cause of morbidity and lost productivity in the work force today (Mitchell et al, 1994). A considerable number of people have permanent discomfort from LBP with chronic LBP being present in 3% to 7% of the population (Jellema P et al. 2001). The impact of low back injuries affects businesses, the workers and society in general. Some place the cost for back injury at 5 to 10 billion dollars per year (Kraus et al, 2002).

The etiology of low back injuries is complex. They are in part due to improper body mechanics (Felstein et al, 1993). There has been significant biomechanical research done studying how the musculoskeletal tissues of the lower back are affected by the parameters of job demands, such as postures required to perform a task and the forces exerted during manual materials handling tasks (Keyserling, 2000). Risk factors previously studied include heavy physical activity and various lifting activities (Frymoyer et al, 1983; Kelsey et al, 1988; Fuortes et al, 1994; Daltroy et al, 1991; Kraus et al, 1997; Gardner et al, 1999), history of prior injury (Walsh et al, 1990; Daltroy et al, 1991; Mitchell et al, 1994), age (Daltroy et al, 1991), smoking (Kelsey et al, 1988; Frymoyer et al, 1983), work related stress (Myers et al, 1999; Fransen et al, 2002; Hoogendoorn et al,

2002; Johnston JM et al, 2003), BMI (Myers et al, 1999; Fransen et al, 2002), and gender (Kraus et al, 1997; Daltroy et al, 1991),

The objective of this study was to evaluate the occurrence of low back injury in workers of a large home improvement company with regards to possible risk factors involving job tasks, psychosocial factors, age, BMI, and physical activities.

II. Methods

This study used a case-control matched pairs design looking at possible risk factors for reported low back injury among workers in retail home center businesses. Factors found among employees with a claim for a low back injury were compared with factors of current employees without a claim.

Population

The population included workers from Home Depot retail stores within 9 districts which made up the Western Division stores. These districts included areas in 8 Western Region states: California, Arizona, Nevada, Colorado, Idaho, Utah, Washington, Oregon and Alaska. Sixty-nine percent of the subjects came from California stores with less than one percent coming from Alaska and Idaho (see Table 2). Specific job titles were looked at which were then divided into two main categories: high and medium lifting intensity. High lifting intensity included job groups involving sales and receiving. Sales included various departments such as lumber, hardware and millwork. The medium lifting intensity category included homers and cashiers.

Identification of Cases and Controls

Cases were defined as a current employee of Home Depot who was injured at work, performing routine work activities and had a medically diagnosed low back injury

during the study period. The low back injury is confined to the low back area only where vague anatomic locations are excluded. The worker was categorized either in the Medium or High lifting intensity job title and worked in one of the eight Western region states. Cases came directly from Home Depot from internal injury reports.

Controls were defined as a current employee of Home Depot who has not claimed a low back injury in the 12 months from the index case and can be found on the current payroll record. The employee is matched to case by job title in Groups 1 or 2 and stratified by geographic region similar to case. Controls were matched to a case by Gender, Lifting Intensity, and District.

Telephone contact was made between thirty and sixty days of claim date to interview both groups of employees concerning factors such as demographics, employment history, injury history (including hospitalizations), problems with back injuries of any kind and among those who had a back injury, and details on the sequence of events that led to the injury. Questions also included work history, exercise and life style factors such as smoking and activities outside of work. Three controls were randomly selected for each case. The first control who completed the interview was the match and the remaining two controls were dropped from the pool of eligible controls.

Statistical Methods

Statistical procedures for analysis of matched pairs for dichotomous risk factors and binary outcome variable was measured using the odds ratios (OR) and McNemar's chi-squared statistic to look for an association between case-control status and the risk factor. Continuous variables were categorized and comparisons between cases and

control looking at odds ratios were also used to determine potential risk factors. Factors of p-values <0.1 were considered for further evaluation.

Risk factor variables of interest included job satisfaction, amount of physical work required for the job, lifting of various weights on the job, stretching exercises prior to working, whether subjects felt their supervisor supported safety, how often they wore their back support and did their job duties require back support belt use. Conditional logistic regression was performed using the data on 195 matched pairs. Logistic regression models were first constructed for risk factors within similar categories such as back support use, physical activity and lifting requirements and psychosocial factors. Univariate logistic regression analysis was used to assess six specific risk factors individually to look at associations with back injury. The independent risk factors for which the Wald test p value for the OR was <0.20 were then put into the final model. Age, BMI and smoking status were fitted into the model to test the adjusted effects of these factors of which age and smoking status, using the likelihood ratio test, remained in the model.

Results

Over the study period, 195 cases and 195 controls participated. (Table 1) There were 276 (71%) males and 114 (29%) females. Eighty-five percent of the participants worked in high lifting intensity jobs and 15% worked in medium intensity jobs. A higher percentage of males worked in the high intensity jobs compared to females. The majority of both cases and controls had some college education.

The 25-34 year old age category contained the greatest number of subjects, including within the case and control and gender groups.

The age range of cases was from 17-65 years. The difference in ages between cases and controls was most evident in the oldest and youngest age groups. Thirty percent of cases were in the 16-25 age group compared to 17% of controls. Only 7% of cases were in the over 55 group compared to 15% of controls. On the average, the cases were younger than the controls.

Almost half of the cases reported being injured within 1 year of working for Home Depot. An increase risk for injury with shorter duration of employment has been seen in previous studies (Gardner et al, 1999; Daltroy et al, 1991; Kelsey et al, 1988). From Table 2, fifty-nine percent of cases said they had completely recovered with no permanent problems, 16% were receiving therapy and another 21% reported a permanent disability. Only 54% had a job duty change with 22% getting a temporary or light duty change in jobs.

Eighty-one percent of the cases said they were lifting or picking up an object at the time of their injury with 82% saying that the activity done at the time of injury was a usual job activity for them and 97% said the anatomical region affected was their lower back area. Ninety-six percent of the controls were apt to say their current health was excellent to good, whereas 87% of the cases were to say this. When asked about their health at the time of their injury, 95% of the cases said their health was excellent to good.

Eighteen percent of cases reported having sustained another reported injury at the workplace in the past of which over half of them said they were lifting or picking up an

object at the time of the injury, 23% said they were reaching or "stocking", and 16% said they were twisting or turning while lifting.

Use of back support belts were mandatory for workers. Overall 99.5% of both cases and controls reported wearing back support belts at work which were provided by Home Depot and therefore it is not surprising when 96% of cases reported wearing their back belts at the time of their injury.

Table 4 shows the final results of the final logistic regression model. There appeared to be a dose-response association between jobs that require back supports and back injury with the risk of injury increasing as job tasks require greater use of a back belt. An inverse dose-response association was also seen with job satisfaction level and injury with the risk of injury increasing as job satisfaction decreased. It also appears that those whose job required a moderate amount of physical work were more at risk of injury (OR=5.1) than those whose job required a great deal of physical work (OR=4.2).

More female cases reported having jobs that required a great deal of physical activity compared to female controls and more females reported their jobs required them to sometimes use back supports (Table 4). More male cases said their jobs require them to always use back supports compared to control males who generally said they only sometime need to use back supports. Proportionally less women work in high lifting intensity jobs, less women perform tasks such as lifting material and more work as cashiers (Table 3) compared to men.

Discussion

In looking at the results from the logistic regression, though the odds ratio for jobs requiring back support (OR=10.0) appear large, the confidence interval, though it does

not include the null value, still questions the precision of the measure. In looking at subjects with medium or high lifting intensity jobs, there were few individuals whose job never called for the use of a back belt which may have affected the precision of the measure. As there appears to be a dose-response relationship, it does seem that job activities with higher need for back belt use are a risk factor for potential injury. In a report by Keyserling (2000), workers who were assigned to jobs where the physical demands exceeded the level deemed acceptable by 75% of the population were three times more likely to suffer a back injury than workers in jobs where the physical demands were below the acceptable level by 75% of the population. The conclusion was that up to one-third of compensable back injuries could be prevented by designing jobs to fit at least 75% of the population.

A moderate amount of physical work appeared to be a higher risk for back injury than job activities requiring a great deal of physical work. As seen with females, a great deal of physical work does not necessarily constitute always requiring the use of a back belt. In a review of low back injury causation (Marras 2000) it was seen that pain can be associated with physical loading at various sites along the spine. Spinal tolerances to shear and torsion are less than those to compression. Tolerances to injury are also affected by repetition, time of day and the posture of the spine when the load is applied. It is possible that those who say their jobs require a moderate amount of physical activity may be required to do a more physically demanding jobs, just not as frequently. They may not be as physically prepared having less strength or stamina, or be less experienced in how to manage these more demanding jobs than would someone who does them on a regular basis and, subsequently, be more at more risk of injuring themselves when

undertaking these tasks. Those individuals who consider their jobs as less demanding may also consider their jobs not requiring the use of back supports, potentially putting them at more risk of injury when a back support may help.

It was noted that as job dissatisfaction increases, the risk of back injury also increases. This is also seen with a lack of supervisor support for safety in the crude OR (Table 3). This brings into play possible psychosocial and organizational factors. Findings of psychosocial factors were found in other studies (Hoogendoorn et al, 2002; Johnston et al, 2003; Frymoyer JW, 1992; Myers AH et al, 1999). A study looking at retail material handlers found increase in the risk for back pain among employees who reported high job intensity demands or were dissatisfied with their job (Johnson et al, 2003). Psychological distress has also been associated with chronic occupational back pain (Fransen et al, 2002). It's possible that those who are more dissatisfied with their job may be more likely to report work-related low back injuries and as such, psychosocial risk factors may lower the threshold for reporting injuries (Marras 2000). But in an experiment in situations where psychosocial stress was imposed or not imposed on people performing standard lifting tasks, it was found that not only did gender play a role in how subjects moved in response to stress, but different personality traits can dramatically increase spine loading compared to opposite personality traits (Marras 2000). Johnston et al (2003) also hypothesized that increased psychosocial stress at work may produce changes in posture, may affect muscle tone, movement and exerted forces increasing the risk of back injury. People may move more quickly or stresses may modify awareness so they pay less attention to proper lifting techniques.

This study found a negative association for back injury with age. Age has been associated with low back injuries in previous studies (Gardner et al, 1999; Daltroy et al 1991; Kraus et al, 1997) but this association has not been shown to be consistent (Garg et al, 1992; Frymoyer et al, 1987). Younger age and shorter duration of employment may be related to worker inexperience and increase risk of low back injury but it is also possible that younger workers may be assigned to more physically demanding jobs, thus putting them at higher risk (Daltroy et al, 1991). New workers also may need time to become more physically fit and build the sufficient strength necessary for higher intensity jobs (Kelsey et al, 1988) and once they have adjusted to the job demands, become less at risk for injury. Younger aged workers though wearing their support belts may also be less apt to consistently use them properly in spite of the level of physical activity involved. Shorter duration of employment and younger age may be difficult to interpret because of the tendency for some workers who are prone to recurrent back problems to leave a strenuous job within a short period (Kelsey et al, 1983).

It was also found that there may be an association between those who always stretch before they begin working and incurring a low back injury compared to those who never stretch (OR=2.1) though the confidence interval didn't show this to be significant. Results concerning the benefits of stretching as a means to reduce musculoskeletal injury have been inconsistent. Reviews have shown that stretching can increase flexibility (Smith CA, 1994), and that stretching is beneficial in reducing sprain and strain injuries (Smith RB, 1990). But others have shown no association with lower injury rates (Shier, 1999; Amako et al, 2003; Weldon et al, 2003; Pope et al, 2000) or that stretching was

detrimental (Shier I, 1999) and Howell DW (1984) showed a negative correlation between stretching and low back pain incidence in lightweight women rowers.

Possible limitations in studying the results is the possibility of recall bias leading to misclassification which can be a problem in case-control studies (Zwerling 1993). If the cases recalled things more specifically they may report exposure to certain risk factors more than the controls and this may lead to an overestimation of an exposure association with the outcome. The self-reporting of psychosocial factors or physical work level also might be affected by a history of back pain (Johnston et al, 2003). For example, a case may report decreased job satisfaction or increased job activity as a means to explain their injury. Temporal ambiguity may also play a factor as feelings of lack of managerial support may have increased after the case's injury as opposed to having preceded it and been a risk factor for the injury.

In summary, the results of this study looking at causal models of low back injury showed a strong association with job satisfaction, age, and high physical job activity. These results confirm other literature results. It also reemphasizes that the psychosocial work environment plays in important part and taking consideration of the organizational work environment and giving workers greater support from management through education and communication may be beneficial in the prevention of low back injury.

Table 1. General characteristics of cases and controls

Characteristic	N(%)	Cases (n=195)	Controls (n=195)	Male	Female
		n (%)	n (%)	n(%)	n(%)
males	276 (71)	138	138		
females	114 (29)	57	57		
High lifting intensity job title	298 (84)	153 (51.3)	145 (48.7)	238(97.5)	60(54)
Medium lifting intensity job title	57 (16)	28 (49.1)	29 (50.9)	6(12.5)	51(46)
Age					
16-24	75 (19.3)	49 (25.3)	26 (13.4)	54(19.6)	21(18.8)
25-34	115 (29.6)	54 (27.8)	61 (31.4)	78(28.2)	37(33)
35-44	92 (23.7)	50 (25.8)	42 (21.7)	64(23.2)	28(25)
45-54	63 (16)	27 (13.9)	35 (18)	40(14.5)	22(19.6)
55+	44 (11.4)	14 (7.2)	30 (15.5)	40(14.5)	4(3.6)
BMI					
<18.5		8(4.1)	9(4.6)	6(2.2)	11(9.7)
18.5-24.9		78(40)	78(40)	89(32.1)	67(59.3)
25-29.9		72(36.9)	80(41)	125(45.1)	27(23.9)
>30		37(19)	28(14.4)	57(20.6)	8(7.1)
Education					
Some high school	22(5.7)	16(8.33)	6(3.1)		
High school graduate	107(27.6)	58(30.2)	49(25.3)		
Some college	175(45.1)	89(45.3)	86(44.3)		
College graduate	55(14.2)	22(11.5)	33(17)		
Vocational/trade sch	22(5.6)	9(4.7)	13(6.7)		
Graduate school/prof degree	7(1.8)	0	7(3.6)		
# mos worked prior to injury		187		132 (70.6)	55(29.4)
1-12 mo		88(47)		55 (41.6)	33(60)
13-24 mos		36(19.3)		29(22)	7(12.7)
25-60 mos		36 (19.3)		28(21.2)	8(14.6)
61-240 mos		27 (14.4)		20(15.2)	7(12.7)
Age at time of injury		188		131(69.7)	57(30.3)
10-19 years		12(6.4)		6(4.6)	6(10.5)
20-29		70(37.2)		51(38.9)	19(33.3)
30-39		53(28.2)		34(26)	19(33.3)
40-49		32(17)		21(16)	11(19.3)
50-59		14(7.5)		13(9.9)	1(1.8)
60-69		7(3.7)		6(4.6)	1(1.8)
# who worked a 40 hr week prior to injury		149(76.4)			
# who worked an 8 hr day prior to injury		138(70.8)			

Table 2. Specific frequencies seen in cases concerning activities, health and consequences of low back injury incidence.

VARIABLE	CASE(%)	Male (%) (n=138)	Female(%) (n=57)
Activity at time of injury			
Lifting	81.44	81.2	82.4
Bending	28.4	26.8	31.6
Reaching	20.6	24.6	12.3
Twisting	37.1	45	19.5
Health at time of injury			
Exellent	42.78	42.8	43.8
Very Good	52.03	51.4	52.7
Good	3.09	2.9	3.5
Fair	2.06	2.9	
Changed job duties?	54.12	50.7	63.1
Perm job change	4.17	4.4	3.6
Light duty	21.88	20.4	26.8
No lifting 1-25 lbs	20.83	19.7	23.2
Other work injury?	18.32		

Table 4. Multiple Risk Factor Analysis Using Conditional Logistic Regression

	Cases			Controls			Total		Male		Female	
	Total (%)	males (%)	females (%)	Total (%)	males (%)	females (%)	Adjusted		Adjusted		Adjusted	
		(n=138)	(n=57)		(n=138)	(n=57)	OR	95% CI	OR	95%CI	OR	95%CI
Job requires back support												
Never	2.1	1.5	3.5	4.7	4.4	5.4	1.0		1.0		1.0	
Rarely	5.2	5.1	5.3	11.4	9.4	16.1	3.11	(0.53, 18.39)	3.72	(0.46, 30.10)	4.32	(0.04, 476.21)
Sometimes	45.4	42	52.6	52.3	52.2	51.8	4.99	(0.99, 25.26)	4.59	(0.54, 32.83)	8.35	(0.08, 888.42)
Always	47.4	51.5	38.6	31.6	34.1	26.8	8.54	(1.6, 45.61)	8.78	(1.17, 66.01)	13.07	(0.10, 1696.65)
Stretching prior to work												
Never	50.5	50.4	50.1	59.8	54.4	73.2	1.0		1.0		1.0	
Sometimes	30.9	29.9	33.3	27.3	29	23.2	1.25	(0.73, 2.15)	1.06	(0.55, 2.08)	2.63	(0.71, 9.76)
Always	18.6	19.7	15.8	12.9	16.7	3.57	2.13	(0.999, 4.53)	1.49	(0.65, 3.39)	18.14	(0.63, 523.06)
Physical work required in job												
Little	2.6	2.2	3.5	12.4	8	23.2	1.0		1.0		1.0	
Moderate	38.1	39.1	35.1	37.8	33.3	48.2	5.13	(1.57, 16.74)	3.02	(0.63, 14.38)	3.72	(0.47, 29.53)
A great deal	59.3	58.7	61.4	49.7	58.7	28.6	4.18	(1.24, 14.13)	1.91	(0.39, 9.23)	15.7	(1.61, 152.77)
Job Satisfaction												
Very satisfied	29.9	30.4	29.8	44.9	48.9	35.7	1.0		1.0		1.0	
Satisfied	46.4	47.8	42.1	41.2	37.4	50	1.59	(0.89, 2.84)	2.14	(0.98, 4 66)	0.75	(0.15, 3.79)
Somewhat satisfied	12.9	11.6	15.8	8.8	8.6	8.9	2.25	(0.95, 5.33)	1.99	(0.70, 5.64)	2.61	(0.21, 33.27)
Not satisfied	7.2	8	5.3	2.6	2.9	1.8	4.93	(1.23, 19.71)	5.71	(1.1, 29.70)	1.28	(0.004, 390.04)
Smoking status												
Never smoked	52.6	52.2	54.4	46.4	45.3	48.2	1.0		1.0		1.0	
Smoked in the past	18.6	18.8	17.5	28.9	29.8	28.6	0.63	(0.35, 1.15)	0.71	(0.36, 1.42)	0.42	(0.06, 2.8)
Currently smoking	28.9	29	28	27.7	25.9	23.2	1.31	(0.74, 2.33)	1.3	(0.66, 2.55)	1.70	(0.30, 9.56)
Age												
16-24	25.3	24	28	13.4	15	9	3.12	(1.30, 7.49)	2.64	(0.93, 7.52)	0.92	(0.02, 49.33)
25-34	27.8	27.7	28	31.4	28.8	38.2	1.73	(0.77, 3.88)	2.04	(0.84, 4.92)	0.43	(0.02, 12.73)
35-44	25.8	25.6	26.3	21.7	20.9	23.6	1.32	(0.54, 3.25)	2.05	(0.81, 5.19)	0.13	(0.004, 3.92)
45-54	13.9	13.1	15.8	18	15.8	23.6	1.19	(0.48, 2.3)	1.51	(0.52, 4.39)	0.04	(0.001, 2.76)
55+	7.2	9.5	1.8	15.5	19.4	5.5	1.0		1.0		1.0	

Table 3. Comparison of possible risk factors among case and control subjects

	Cases			Controls			OR	95%CI
	Total (%)	males (%) (%) (n=138)	females (n=57)	Total (%)	males (%) (%) (n=138)	females (n=57)		
Job requirements:								
Lift materials or objects	100	100	100	98.5	99.3	96.4		
Lift objects over head	75.8	81.2	63.2	73.7	81.3	54.4	1.13	(0.69, 1.85)
Operate register	36.6	26.1	61.4	39.2	28.8	64.3	0.85	(0.52, 1.40)
Job requires use of back belts	92.8	93.5	91.2	83.9	86.2	78.6	2.89	(1.35, 6.17)
Lift various weights in job?	99	98.6	100	95.9	97.1	92.9	4	(0.85, 18.89)
Job involves physical activity	97.4	97.8	96.5	87.6	92	76.8	4.8	(1.93, 12.58)
Satisfied with job	76.3	78.3	71.9	86.1	86.3	85.7	0.48	(0.26, 0..91)
Mgr not support safety	88.1	89.9	84.2	95.6	97.8	91	2.71	(1.14, 6.47)
Stretching before begin work	49.5	49.6	49.1	49.2	45.7	26.8	1.44	(0.97, 2.15)

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